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ABSTRACT

A study was conducted to determine (1) the nature and range of self-testing procedures that college students use to monitor their reading comprehension; (2) whether their epistomological beliefs influence the nature of their comprehension monitoring procedures; and (3) whether the level of processing dictated by the test component of their reading comprehension plan influences their grades. Ninety undergraduates completed survey forms asking them to describe how they monitored their comprehension of textbooks. Reported criteria were classified as involving the retrieval of text propositions (knowledge standard) or the transformation of text propositions (comprehension/application standard). Students were then classified as having "dualistic" (perceiving knowledge as isolated facts and answers) or "relativistic" (perceiving knowledge as an organization of facts and concepts) beliefs about the nature of knowledge. Students were also classified as high or low inventives (reporting few or many emotional blocks, respectively). Results indicated that the dualists were significantly more likely to use the knowledge standard than were the relativists, and that students reporting the use of comprehension /application criteria earned significantly better grades than did those using the knowledge criteria. High inventives used more monitoring criteria than did low inventives and were more likely to use monitoring strategies that combine the two standards. Students using many monitoring criteria earned significantly better grades than did those using only one. (Copies of the survey forms are appended.) (Author/FL)

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Monitoring Text Comprehension: Individual Differences in Epistemological Standards

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Abstract

Undergraduates read textbook chapters with varying degrees of effectiveness. One basis for such differences lies in the standards by which they judge text comprehension. The nature of one's comprehension standards should depend upon his or her implicit epistemological beliefs and should determine the quality of his or her academic performance. Ninety students enrolled in an introductory psychology course were interviewed and asked to describe how they monitored their comprehension of textbook chapters. Reported criteria were classified as involving the retrieval of text propositions (the Knowledge standard) or the transformation of text propositions (the Comprehension/Application standard). Students were classified as having dualistic (perceiving knowledge as isolated facts and answers) or relativistic (perceiving knowledge as an organization of facts and concepts) beliefs about the nature of knowledge on the basis of their ratings of attitudinal statements drawn from Perry (1968). Results showed that Dualists are significantly more likely to use the Knowledge standard than are Relativists. Students reporting the use of Comprehension/Application criteria earn significantly better grades than do students reporting the use of Knowledge criteria. Students were also classified as high inventive (reporting few emotional blocks in their problem solving efforts) or low inventive (reporting many emotional blocks) on the basis of their ratings of attitudinal statements drawn from Adams (1976). High Inventives report using more monitoring criteria than do Low Inventives and are more likely to report using monitoring strategies which combine Knowledge and Comprehension/Application standards.

Students reporting many monitoring criteria or combined-standard strategies earn significantly better grades than do students reporting only a single criterion. These results are interpreted in light of Miller, Galanter, and Pribram's (1960) discussion of Images and Plans. In this context, naive beliefs about the nature, methods, and limits of knowledge constitute an epistemological Image within which a student invents comprehension monitoring criteria that function as epistemological standards. These standards are incorporated into the test component of a text comprehension Plan and control the nature and extent of one's reading efforts. Comprehension standards, therefore, link one's epistemological beliefs with his or her reading competence.

Monitoring Text Comprehension:

Individual Differences in Epistemological Standards

Adult readers vary dramatically in the way they study text materials, and these differences are associated with the quality of their performance on college examinations (Pask, 1976; Svensson, 1977). Historically, differences in cognitive competency have been attributed to variations in developmental level, intellectual ability, cognitive style, and learning strategy (Entwistle, 1979). More recent research, however, has focused on the degree to which adult readers understand their own thought processes (Säljö, 1979) and the nature of the reading process (Gambrell & Heathington, 1981).

Anderson (1979), for example, highlights the role of comprehension monitoring in the reading process. He argues that both automatic and conscious monitoring mechanisms can signal a reader that the comprehension effort has failed and that some tactical action (e.g., reread some portion of the text, consult an outside source) is required. Anderson does not speculate about the nature of the comprehension standards that must be embodied in these monitoring mechanisms nor does he entertain the possibility that there might be significant individual differences in these standards. Given that Markman and Gorin (1981) have shown that the comprehension standards of young children can be manipulated so as to influence the nature of the errors they discover in a short paragraph, it is likely that the comprehension standards of adult readers do play a critical role in the reading process. The present study offers a

description of individual differences in the comprehension standards of adult readers and examines the origins and effects of these differences.

Text comprehension strategies are best understood as comprehension Plans (Miller, Galanter, & Pribram, 1960). A Plan consists of a test component and an operate component. The test component determines whether a particular condition (e.g., Is thesis of last paragraph available in memory?) exists or not. If the condition exists, then the reading process continues; if the condition does not exist, then the operate component of the Plan is activated in order to modify the results of the test (e.g., Reread paragraph).

The effectiveness of any Plan will depend upon two factors. First, the test component must be sensitive to just those information conditions which specify an appropriate performance. Second, the operate component must be able to eliminate any significant discrepancy between a current information state and that mandated by the test component. The test component plays the more crucial role in behavior because it monitors and regulates the actions of the operate component. As Miller et al. point out, behavior may be "most conveniently conceived as an effort to modify the outcome of the test (1960, p. 25)." In this context, the test that one performs to evaluate one's comprehension of text passages will reflect the dimensions of the text to which he or she attends and will determine what actions are involved in the comprehension effort.

The foregoing interpretation of the comprehension process is well illustrated in the Markman and Gorin (1981) study. They were able to modify the number of false facts or logical inconsistencies which young

children detected in short paragraphs simply by focusing the children's attention on factual or on logical errors through the careful construction of sample paragraph "problems." Essentially, Markman and Gorin controlled the outcome of the reading process by biasing the test component of their subjects' comprehension Plans. If the comprehension standards embodied in the test components of text comprehension Plans are malleable to this extent, then it is likely (in the absence of formal instruction in text comprehension standards) that adult readers will vary widely in the standards they employ because of different social learning histories.

Individual differences in text comprehension standards will reflect different conceptions about the desired outcome of the reading process. One individual may, for example, view reading as an effort to discover and store important facts; another may view it instead as an effort to identify and label the relationships that exist among a set of concepts (cf. Svensson, 1977). These two individuals would orient to different aspects of a text in order to monitor their comprehension. The first individual is likely to focus on the number of new and interesting facts he or she can recall from the text; the second is likely to focus on the degree to which he or she can integrate text propositions in a coherent way. One's conception of the outcome of the reading process thus leads to the construction of monitoring procedures which are appropriate for assessing whether that particular outcome has been attained or not. Monitoring procedures, therefore, can be said to incorporate operational definitions of one's conception of reading outcomes. In Miller et al.'s (1960) terminology, the Image of the reading outcome constrains the

nature of the input to the test component of a text comprehension Plan.

Perry (1970) provides a useful theoretical context within which to describe individual differences in the reading outcome Images of adults. On the basis of a longitudinal study of Harvard undergraduates, he argues that college students move through a fixed sequence of epistemological stages in coming to a mature understanding of intellectual and ethical issues. The most fundamental transition in his schema is that involved in moving from a primitive conception of knowledge as an unorganized set of discrete and absolute facts to a more mature conception of knowledge as interpreted and integrated fact arrays. Perry describes this transition as the movement from a Dualistic (i.e., right or wrong, true or false) to a Relativistic conception of knowledge. Given that one's conception of knowledge constitutes a set of working assumptions about the nature, methods, and limits of understanding, Dualists and Relativists can be said to subscribe to different epistemological theories. Since these epistemological Images involve unspoken assumptions about the nature of knowledge and learning, they are implicit rather than explicit and may be deduced from the pattern of intellectual behavior in which an individual engages.

Although Perry does not examine the information processing strategies that are associated with each of the epistemological "positions" he identifies, it can be assumed that one's implicit epistemology would determine one's conception of the outcome of the reading process and influence in turn his or her choice of comprehension standards. For this reason, one's comprehension standards are most usefully described as the

realization of one's implicit epistemological theory and can be referred to as epistemological standards. A Dualist will conceive of the outcome of the reading process as the discovery of discrete Truths and will judge his or her comprehension in terms of the number of propositions which can be recalled after reading a text passage. In contrast, a Relativist will conceive of the outcome of the reading process as the discovery of a logical structure and will correspondingly judge his or her comprehension in terms of the degree to which clear and coherent relationships can be established among the propositions in a text passage.

A second source of individual differences in comprehension standards involves one's ability to operationalize his or her epistemological Image in order to monitor some specific aspect of the reading process. One's epistemological Image will define a set of perceptual dimensions (cf. Wish, Deutsch, & Biener, 1972) or personal constructs (cf. Kelly, 1955) which represent potential sources of input for the test component of a reading comprehension Plan. However, even individuals with identical epistemological Images may differ in the number of dimensions they can combine in their comprehension monitoring efforts or in their ability to devise some means for monitoring a particular dimension of the Image. For this reason, individuals will vary in their ability to invent criteria which transform implicit epistemological beliefs into explicit epistemological standards so as to provide a basis for monitoring the reading process. Individuals can be said, therefore, to differ in their "construction competencies" (Mischel, 1973) as well as in their epistemological Images. Thus individuals who share a Dualistic Image of reading

outcomes may differ from one another in the number, variety, and effectiveness of the procedures they employ to assess the number of text propositions they have available in memory.

One's epistemological standards influence his or her ability to comprehend and retain text information by determining the level at which the text is processed (cf. Craik & Lockhart, 1972). One can, for example, assess his or her comprehension of a passage of text by reciting the important points that were presented in that passage (cf. Robinson, 1970) or by constructing a schematic "map" of the conceptual relationships that link those points together (cf. Hanf, 1971). The recitation test orients one toward the identification and rehearsal of isolated facts; in contrast, the mapping test orients one toward the elaboration of relationships among facts. The mapping standard encourages a deeper level of text processing than does the recitation standard, and the student who employs mapping procedures to monitor text comprehension should retain more text information than a student who employs recitation procedures (Kunen, Cohen, & Solman, 1981). But mapping procedures should also promote greater text comprehension than would recitation procedures because of the explicit focus on conceptual relationships. Insofar as both memory and understanding are concerned, therefore, the mapping test constitutes an epistemological standard which mediates superior performance.

It should be emphasized, however, that the mapping test simply represents a standard to be met -- a student may engage in a variety of very different behaviors in order to meet the epistemological goal of diagramming conceptual relationships, and he or she may elect not to

attain that goal during a particular reading episode. Epistemological standards are critical in the reading process because they monitor and regulate specific cognitive operations. It is those cognitive operations which directly create the changes in memory structures that are equated with the acquisition of knowledge and understanding (cf. Rumelhart & Norman, 1977). The extent to which those changes support effective performance on a classroom examination depends upon the degree to which the cognitive operations occuring during text processing simulate those required during the examination (Morris, Bransford, & Franks, 1977).

Although some investigators have examined individual differences in reading and study strategies (e.g., Gambrell & Heathington, 1981; Pask, 1976), little information is available concerning individual differences in the epistemological standards that control those strategic operations. Perry's (1970) survey of individual differences in epistemological beliefs and recent research on learning styles (e.g., Marton & Säljö, 1976; Svensson, 1977) imply the existence of differences in the way that individuals assess their comprehension of text, but no direct information about such differences is available. The present study was designed to collect more direct evidence concerning the role of epistemological standards in the reading behavior of college students.

Students in this study were asked to describe how they would decide whether they had understood a textbook chapter. Each reported comprehension criterion was classified as involving information retrieval or as involving information transformation. These two categories were chosen to parallel the Knowledge and the Comprehension/Application

categories, respectively, of The taxonomy of educational objectives: Cognitive domain (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). Each student was classified according to the degree of dualism exhibited in his or her ratings of attitudinal statements designed by Perry (1968). Those students with high dualism scores were labelled as having dualistic beliefs about the nature of knowledge and learning, and those with low dualism scores, as having relativistic beliefs. Although there is a clear need for a more formal and comprehensive analysis of implicit epistemological theories than that offered by Perry, his distinction between dualistic and relativistic orientations is upheld by other work (e.g., Pask's, 1976, distinction between atomists and holists). More importantly, the dualist/relativist distinction provides a simple framework within which to predict the epistemological standards that a given individual is likely to use.

Each student was further classified according to the level of construction competency he or she would exhibit in deriving specific epistemological practices from his or her epistemological beliefs. In order to operationalize this motive as an aspect of one's implicit epistemological beliefs rather than as intellectual or creative ability, attitudinal statements were derived from Conceptual blockbusting: A guide to better ideas (Adams, 1976). Those students who rated themselves as susceptible to the emotional blocks to creativity described by Adams were assumed to be unwilling to be creative or inventive in their problem solving efforts and were labelled as "uninventive"; those students who reported that they were not susceptible to such emotional blocks were

labelled as "inventive."

Finally, course grades in introductory psychology were used to determine the effectiveness of students' comprehension monitoring Plans. These grades were used because they are based on objective examinations which emphasize one's knowledge and comprehension of assigned textbook chapters.

This study has three specific goals. The first is to determine the nature and range of testing procedures that college students use to monitor their reading comprehension.

The second goal is to determine whether one's epistemological beliefs influence the nature of one's comprehension monitoring procedures. In particular, it is predicted that students who evince dualistic attitudes will tend to use monitoring procedures which involve information retrieval while students who evince relativistic attitudes will tend to use monitoring procedures which involve information elaboration and transformation. It is also predicted that students who exhibit inventive attitudes will use a greater number and variety of monitoring procedures than students who exhibit less inventive attitudes.

The third goal is to determine whether the level of processing dictated by the test component of one's reading comprehension Plan influences his or her course grades. It is expected that information retrieval criteria demand less cognitive elaboration or "deep" processing than do information transformation criteria. Therefore, individuals whose epistemological standards focus on information retrieval or Knowledge criteria should understand and retain less of what they read than will

individuals whose epistemological standards focus on information transformation or Comprehension/Application criteria.

Methods

Subjects

Fifty-eight female and 33 male students at The University of Texas at San Antonio volunteered to participate in a survey of "study skills" in order to satisfy a course requirement in Fundamentals of Psychology. Fifty-four students were freshmen; 24, sophomores; 7, juniors; and 6 seniors. Thirty-five students had declared majors in the College of Business; 19, in the College of Sciences and Mathematics; 14, in the College of Humanities and Social Sciences; 6, in the College of Education; and 2, in the College of Fine and Applied Arts. The remaining fifteen students in the sample had not yet declared a major.

Materials

Students filled out individual interview forms which requested information about their academic attitudes and strategies. The attitude survey consisted of statements of feelings or behaviors which might occur in a college environment. The statements were rated by students according to the frequency with which they engaged in a described behavior or experienced a described feeling (1 = rarely, 2 = sometimes, 3 = frequently, 4 = generally, 5 = almost always). Ratings on seven of these survey items determined a student's dualism score; ratings on another nine determined his or her inventiveness score.

Epistemological orientation. Students were classified as having a dualistic or a relativistic orientation to knowledge on the basis of

their dualism scores. The seven items were drawn from Perry (1968) and are shown in Appendix A. Perry characterizes dualism as involving a spelling-test conception of knowledge, within which the accumulation of facts and answers is valued more than the development of perspectives or interpretations. As can be seen in Appendix A, each of the items reflects a dualistic orientation. The mean rating for each student on these seven items provides an index of his or her level of dualism. Students with dualism scores of 3.0 or greater were classified as Dualists. Those students with lower scores were classified as Relativists. Strictly speaking, these students are simply non-Dualists. However, Perry characterizes relativism as involving a contextual definition of knowledge, within which establishing relationships among facts and concepts is valued more than memorizing important facts or answers. Given that such an orientation would imply a lack of agreement with the statements in Appendix A, non-Dualists are referred to here as Relativists.

The mean dualism score of the 46 Dualists is 3.47 (SD = .45); that of the 44 Relativists is 2.43 (SD = .35). The percentage of Dualists did not vary as a function of sex or academic major in this sample. However, the percentage of Dualists did vary as a function of class year. Sixty-one percent of the freshmen (n = 54) were Dualists, but only 38% of the sophomores, juniors, and seniors (n = 37) were so classified, z = 3.23, $p < .001$. This result supports Perry's (1970) contention that dualism represents an early stage of epistemological development.

Inventiveness. Students were classified as High or Low Inventive on the basis of their ratings of nine statements. The nine scale items

in Appendix B were derived by the author from Adams' (1976) discussion of "emotional blocks" to creative thought. Adams describes such blocks as those which "interfere with the freedom with which we explore and manipulate ideas, with our ability to conceptualize fluently and flexibly (1976, p. 52)." Each of the nine items in Appendix B represents a potential emotional block which might limit an individual's ability to derive explicit epistemological standards from his or her implicit epistemological beliefs. The mean rating for each student on these nine items provides an index of the degree to which his or her inventiveness is not limited by emotional blocks. The distribution of inventiveness scores was cut at the median to define groups of High and Low Inventive students.

The mean inventiveness score of the 41 students classified as High Inventives is 3.76 (SD = .25); that of the 40 students classified as Low Inventives is 2.91 (SD = .37). Ten students scored at the median in this distribution; their data are not included in any analysis involving the cognitive flexibility variable. The percentage of High Inventives does not vary as a function of sex, major, or class year.

Comprehension monitoring probe. As part of the survey, students were asked to write detailed explanations of how they evaluated their comprehension of textbook chapters:

> How do you determine (when you have completed a reading assignment or when you are reviewing the material) whether you have understood the material well enough? What specific information do you use to assess the

degree to which you have understood the material you have read in a chapter? On what basis would you decide that you needed to go over the chapter again or to seek help in figuring it out?

Each protocol was analyzed to determine the specific comprehension tests employed by each student. An effort was made to score each protocol for as many different comprehension criteria as possible in order to capture the full range of a student's comprehension monitoring capabilities.

Procedure

Students were scheduled in groups of three for a 90-minute session. Each student worked on his or her interview booklet in a separate study carrel in a quiet, pleasant room in the library. An interviewer paced students through the booklet, allowing them ten minutes to rate the 50 attitude statements and fifteen minutes to describe their textbook reading strategies. (Students described their note-taking, paper-writing, and question-answering strategies during the remainder of the session.) Pilot interviews had shown that students are sometimes unhelpfully brief in their written responses. For this reason, several measures were taken to motivate students to provide relatively complete descriptions of their monitoring strategies. First, they were instructed to write strategy descriptions that were complete enough to be used as a set of instructions by other students who might be in need of better strategies. Second, they were informed about the relative lack of information about adult comprehension monitoring strategies and the relevance of such information for improving student study skills. Finally, students were run

in small groups and under close supervision in order to maximize the demand characteristics of the situation. These procedures were effective in obtaining enthusiastic and conscientious written descriptions from all but a few students.

Course grades. Course grades in Fundamentals of Psychology are determined by a student's overall performance on a series of five tests and a comprehensive final. Each test is composed of multiple-choice questions based on three or four chapters in Hilgard, Atkinson, and Atkinson's (1979) Introduction to Psychology. These questions represent a mixture of items; some assess a student's ability to recall text information (cf. Bloom et al.'s, 1956, Knowledge category) and others, a student's understanding of text information (cf. Bloom's et al.'s Comprehension and Application categories). Each of the questions on the best four of the five 50-item midterms and on the 50-item final counts equally toward a student's course total. Letter grades of A, B, C, and D, respectively, are assigned to those earning 88%, 79%, 65%, and 52% of the total number of possible points. These letter grades are classified here as "good" (an A or a B), "average" (a C), or "poor" (a D or an F).

Results

Comprehension Monitoring Procedures

Two major steps are involved in assessing one's comprehension of a chapter of text. First, one must gather what he or she believes to be relevant input for the comprehension judgment. Second, one must evaluate this in order to determine whether his or her comprehension goals have been achieved or not. The present analysis focuses on the first step.

Fifteen different kinds of monitoring behaviors were identified in the written protocols of 90 subjects. One student's comments were completely unscoreable because he failed to refer to a specific behavior that provided him with the input for his comprehension judgment (i.e., "Just by the way I react or feel about the stuff that I have read.") In other instances, students referred to as many as four different types of monitoring behaviors that they were prepared to use to evaluate their text comprehension. All monitoring behaviors were further classified according to the epistemological standards they implied. The Knowledge and Comprehension/Application categories described by Bloom et al. (1956) represented the two categories of epistemological standards into which all monitoring behaviors were classified. Examples of the fifteen kinds of monitoring procedures are organized in Table 1 according to the epis-

Insert Table 1 about here.

temological standard each implies and to the relative frequency of each within that category.

Three general observations may be made concerning Table 1. First, it is clear that college students report a wide range of very specific comprehension monitoring behaviors. Within the Knowledge category, for example, some students simply engage in free recall efforts whereas others make use of chapter subheadings in an informal cued-recall test. Within the Comprehension/Application category, on the other hand, some students attempt only to make sense of individual sentences while others seek to establish relationships among sentences within the context of

chapter subheadings. The degree of specificity illustrated in these monitoring criteria suggests that monitoring behaviors may be an important source of individual differences in reading competence.

A second observation concerns the variety of monitoring criteria used by individual students. Over half of the students in the sample (49 out of 90) reported using more than one source of input for their comprehension tests; almost one-third of the sample (27 out of 90) reported using criteria from both the Knowledge and the Comprehension/Application categories. Given the relative frequency of multiple monitoring criteria, it is clear that a major component in any model of text comprehension must be a process by which a particular criterion is selected for a given comprehension test or a process by which several criteria are combined into a single index of comprehension.

A final observation concerns the relative lack of sophistication of the criteria that college students use to monitor text comprehension. The most popular monitoring criteria from the Knowledge category resulted from the student's effort to respond to chapter or study guide questions or from some form of mental review. While study guide questions fairly represent the population of potential test questions in many introductory courses, the majority of such items only assess the student's ability to recall key terms or facts. The mental review process described by students in this sample involves a free recall test in which he or she attempts to retrieve a given number of key definitions or facts. Neither of these two Knowledge tests is as demanding as that involved in recalling the text propositions associated with a given chapter subheading or

with a particular statement in a chapter summary. The most popular monitoring criteria from the Comprehension/Application category resulted from students' efforts to paraphrase individual sentences or to summarize the chapter in their own words. While comprehending every sentence or developing a personal summary of what one has discovered are both laudable goals, neither of these two tests is as demanding as that involved in determining the author's intentions or in integrating text and lecture materials. None of the students in this sample attempted to develop integrated text representations of the sort recommended by many researchers (e.g., Anderson, 1979; Dansereau, 1978; Merritt, 1977). As Anderson (1979, p. 72 ff.) argues, such procedures provide the student with a concise map of the nature of the relationships among the ideas contained in a chapter of text.

The Impact of Epistemological Beliefs on Comprehension Monitoring Procedures

The primary purpose of this study is to demonstrate the influence that one's implicit epistemology has upon the test component of his or her comprehension monitoring Plan. Perry's (1970) distinction between dualistic and relativistic epistemological orientations is most useful in this context. First, it provides a convenient means of classifying beliefs that are likely to be both complex and relatively inaccessible. Second, it leads to straightforward predictions about the nature of one's comprehension monitoring procedures: Dualists should use Knowledge-based monitoring procedures if their epistemological standards are derived from their epistemological beliefs; correspondingly, Relativists should use

Comprehension/Application-based monitoring procedures (see Table 1).

Each student's comprehension monitoring strategy was classified as involving Knowledge criteria or Comprehension/Application criteria. If more than one strategy was reported, and not all belonged to the same criteria category, the student's comprehension monitoring was classified as Mixed. Thirty-six students were found to be using Knowledge-based monitoring strategies, and 27 were found to be using Comprehension/Application-based monitoring strategies. Twenty-seven students used Mixed strategies. The number of Dualists and Relativists using each kind of strategy is shown in Table 2.

Insert Table 2 about here.

Since no clear prediction can be made concerning the incidence of Mixed monitoring among Dualists or Relativists, the critical analysis involves only that set of 63 students who use Knowledge monitoring or who use Comprehension/Application monitoring. Seventy-one percent of the Dualists in this group (n = 31) used only Knowledge-based comprehension monitoring, and 44% of the Relativists (n = 32) did so. The difference between these proportions is highly significant, z = 3.21, p <.005. It may be concluded that one's epistemological Image influences one's choice of input to the test component of his or her text-comprehension monitoring Plan. In contrast, one's level of inventiveness has little impact on the nature of his or her comprehension monitoring strategies, as can be seen in Table 2. Sixty-three percent of the Low Inventives not using a Mixed strategy (n = 30) engaged in Knowledge monitoring, as

compared to 52% of the High Inventives not using a Mixed strategy (n = 25), z = 1.21. The fact that epistemological orientation and level of inventiveness have empirically distinguishable effects suggests that Dualists are not simply lacking in creativity but have instead a particular epistemological commitment.

Variety and number of comprehension tests. It can be seen in Table 2 that 33% of all Dualists (n = 46) and 27% of all Relativists (n = 44) use Mixed-monitoring strategies. The difference is not significant, z = 1.63. However, one's level of inventiveness does predict the likelihood of his or her using Mixed monitoring. Thirty-nine percent of the High Inventives (n = 41) report Mixed strategies, but only 23% of the Low Inventives (n = 39) do so, z = 2.21, $p < .05$. Thus one's inventiveness is more important in determining the range of comprehension criteria he or she employs than is one's epistemological orientation. The value of the inventiveness scores is more directly demonstrated when the number of comprehension tests reported by a student is considered. Table 3 shows

Insert Table 3 about here.

the number of comprehension tests as a function of inventiveness. Forty-nine percent of the Low Inventives (n = 39) reported using two or more comprehension tests; in contrast, 66% of the High Inventives (n = 41) reported using two or more comprehension tests, z = 2.22, $p < .05$. However, as can be seen in Table 3, one's epistemological orientation does not influence the number of comprehension tests he or she reports. Fifty-two percent of the Dualists (n =46) and 57% of the Relativists

(n = 44) reported using two or more tests, s = 0.63. These results demonstrate that one's inventiveness is also more important in determining the number of comprehension criteria he or she employs than is one's epistemological orientation. In summary, the data suggest that individual's differ not only in their epistemological beliefs but also in their ability to translate these beliefs into specific practices.

The Impact of Comprehension Monitoring Procedures on Academic Performance

The third purpose of this study is to examine the impact that a student's comprehension monitoring strategy has on his or her course grade. To the extent that one monitors his or her ability to paraphrase, to integrate, or to apply the information in a chapter of text, he or she will be engaged in relatively "deep" processing (cf. Craik & Lockhart, 1972) while reading. On the other hand, if one only monitors his or her ability to recall text propositions, the processing is more "superficial." Clearly, deep processing would result in a better understanding of the material in a chapter than would more superficial processing. But it is also known that deep processing results in better recall and recognition performance than does superficial processing (Craik & Tulving, 1975). Since deep processing promotes greater understanding and greater recall, it is likely that students employing such strategies will perform better on classroom examinations than will students employing more superficial processing strategies. For this reason, students using Comprehension/Application standards (see Table 1) to monitor their reading efforts should earn higher test and course grades than should students using

Knowledge standards.

Academic performance is shown as a function of a student's text-comprehension monitoring strategy in Table 4. Three students received an "Incomplete" in the course and have been dropped from all course grade analyses. Although there is a greater percentage of "good" grades for

Insert Table 4 about here.

the Mixed group (52%, n = 27) than for the Comprehension/Application group (42%, n = 26), the difference is not significant, z = 0.99. Since members of the Mixed group had all reported using a comprehension test from the Comprehension/Application category, the two groups were combined into a single group for the critical comparison between Knowledge and Comprehension/Application standards. (This grouping involves the assumption that Bloom et al.'s, 1956, taxonomy represents a Guttman scale and that it is reasonable to characterize an individual in terms of the highest epistemological standards to which he or she subscribes.) Twenty-six percent of the students using only Knowledge standards to evaluate their text comprehension (n = 34) received "good" grades — that is, a course grade of A or B in introductory psychology. Forty-seven percent of the students in the combined Mixed and Comprehension/Application group (n = 53), however, earned "good" grades. The difference is highly significant, z = 2.90, $p < .005$. The fact that students who make use of Comprehension/Application standards are almost twice as likely to earn a grade of B or better as those who only use Knowledge standards highlights the critical role of the test component in text

comprehension Plans. Epistemological standards which demand a higher level of text comprehension by the student are associated with better understanding of and retention of text information as measured by classroom examinations.

Variety and number of comprehension tests. The importance of using a range of epistemological standards can be assessed by comparing the academic performance of students using single-standard strategies (i.e., only Knowledge criteria or only Comprehension/Application criteria) with that of students using multiple-standard strategies (i.e., the Mixed strategy group). A reanalysis of the data in Table 4 reveals that 52% of those using multiple standards (n = 27) earned "good" grades, but only 33% of those using a single standard (n = 60) did so. This difference is significant, $z = 2.51$, $p < .025$.

One advantage of a multiple-standard strategy is that it provides the reader with alternative criteria for evaluating comprehension and ensures thereby a relatively severe test of comprehension. A beneficial effect should be seen for those students who use more than two or more comprehension criteria, even if the criteria represent different ways of monitoring the same epistemological standard. Table 5 shows the percentage of "good" grades as a function of the nature and number of a student's comprehension tests. Seventeen percent of those using only one Knowledge criterion (n = 23) received As or Bs in introductory psychology, but 46% of those using two or more Knowledge criteria (n = 11)

Insert Table 5 about here.

received such grades, $z = 2.62$, $p < .01$. Likewise, 33% of those using a single Comprehension/Application criterion ($n = 18$) earned "good" grades, and 63% of those using two or more Comprehension/Application criteria ($n = 8$) earned such grades, $z = 2.20$, $p < .05$. These data show clearly that the sheer number of comprehension criteria that one has at his or her disposal influences the quality of text processing.

Discussion

The central role of epistemological standards in the reading process is highlighted in this study by several important findings. First, epistemological beliefs predict an individual's comprehension standards. Those who conceive of knowledge and understanding as facts and answers are likely to assess their reading comprehension with respect to the amount of information they can recall. In contrast, those who conceive of knowledge and understanding in less absolute terms are likely to assess their reading comprehension with respect to the degree to which they can integrate and apply text information. Second, the number and variety of comprehension monitoring criteria that can be employed is a function of an individual's inventiveness rather than of his or her epistemological beliefs. More creative individuals report using a greater number and a wider range of criteria than do less creative individuals. Third, the nature of one's comprehension standards predicts his or her course grades. Standards which demand the integration and application of text material are associated with higher course grades than are standards which demand only the retrieval of text propositions. Finally, individuals using a number or a variety of comprehension criteria earn higher

course grades than those who do not.

These findings demonstrate that reading competence is both Image- and Plan-dependent. The following interpretation provides a fruitful integration of these data: The nature of one's epistemological Image determines one's choice of comprehension standards, and these standards serve to restrict the range of acceptable monitoring criteria. Individuals differ not only in the nature of their epistemological Images, but also in their ability to operationalize those Images. Some individuals are both ingenious and prolific in translating their implicit epistemologies into practical comprehension Plans; others are less skillful or less persistent in their efforts to apply their epistemologies. The epistemological standards embodied in one's comprehension Plan determine the specific character of one's reading performance. The nature, number, and variety of monitoring criteria used in the test component of a text comprehension Plan determine a student's level of satisfaction with his or her reading efforts. In conjunction with one's task motivation, this satisfaction index dictates whether additional text processing is necessary. The operate component of the comprehension Plan is less critical, therefore, than the test component because of the feedback control exerted by the test component. It is the degree of congruence between the epistemological standards incorporated in the test component of the comprehension Plan and the performance standards enforced by an instructor through course examinations that finally links a student's epistemology with his or her level of academic competence. The foregoing interpretation is elaborated in more detail in the following discussion of the

specific findings of this study.

The demonstration that epistemological beliefs are predictive of comprehension standards is of particular importance. Current work on individual differences in reading styles at the college level has focused more on the performance consequences of style differences than on their causes (cf. Entwistle's, 1981, review). While such work is valuable, it is essentially descriptive and fails to provide a basis for intervention. The very provocative early work by Perry and his colleagues at the Bureau of Study Counsel (Perry, 1970) focused clearly on the epistemological origins of different cognitive styles, but it failed to examine the comprehension strategies of students with different epistemological beliefs. The present approach integrates previous findings by assuming that one engages in the reading process in order to satisfy certain epistemological standards. If one's epistemological Image involves only dualistic aspects of knowledge (e.g., the truth value of a proposition, the number of propositions), these dimensions will constitute the universe of potential epistemological standards from which the individual draws his or her set of comprehension monitoring criteria. If one's epistemological Image involves relativistic aspects of knowledge (e.g., degree of internal coherence in a text or argument), then very different dimensions will constitute the universe of potential epistemological standards. This study shows that individual differences in the conception of knowledge result in predictable differences in the nature of test procedures in students' comprehension Plans. The study does not address the larger question of whether these attitudinal differences represent stages in a

developmental process (Perry, 1970) or the outcome of modeling and reinforcement procedures in previous educational settings (cf. Mischel & Grusec, 1966).

The demonstration that one's creative potential influences the number and variety of test criteria in his or her comprehension Plan implicates a new variable in metacognitive development. That variable is the ability to devise procedures by which to monitor one's cognitive behavior. Although one may conceive a variety of text properties within a particular epistemological Image, there is a separate process in which one devises procedures for incorporating these properties into a viable comprehension test. It may be assumed that individuals vary in their ability to implement their epistemological beliefs in this way and that this ability is indexed by the inventiveness scores used in the present study. For this reason, it is not surprising that the inventiveness measure predicts the number and variety of comprehension monitoring criteria that an individual uses. The fact that the dualism measure does not predict the number or range of criteria suggests that the two measures are tapping different components in a process which results in the construction of comprehension Plans. These data suggest that the individual plays an active role in designing or adopting metacognitive procedures. The inventiveness measure, however, only assesses a student's willingness to engage in creative problem solving (see Appendix B). It is likely that general and specific intellectual skills are also involved in the development of comprehension monitoring procedures (cf. Flavell's, 1970, discussion), but the present study offers no information concerning

their role in the process.

The fact that students who employ Comprehension/Application criteria in their monitoring strategies receive better grades than those who employ Knowledge criteria is consistent with a level of processing interpretation (Kunen et al., 1981). The Comprehension/Application criteria illustrated in Table 1 would orient an individual to a relatively deep level of text processing; such processing would ensure better understanding and better retention than would be obtained with the more superficial processing that Knowledge criteria would induce. What is of greatest significance here, however, is the critical role played by the test component of the comprehension Plan. Half of the students whose Plans evaluated Comprehension/Application criteria earned course grades of A or B; only a quarter of the students whose evaluation was limited to Knowledge criteria did as well. This outcome suggests that a student's epistemological standards serve not merely to monitor the comprehension process but also to regulate that process. The present study supplements Anderson's (1979) analysis in a particularly useful way. Although he assumes that automatic and conscious comprehension monitoring mechanisms initiate such corrective actions as rereading some portion of a text or consulting an outside source, he fails to consider the nature of the input to these monitoring mechanisms nor the possibility that this input might not be the same for different individuals. An important implication of the data reported here is that one's monitoring mechanism is potentially of greater significance than one's corrective action mechanism. Even corrective actions that involve deep processing are of little value

if they are not activated by the monitoring mechanism.

The fact that students who report using a variety of monitoring criteria earn better course grades than those who report a single criterion further underscores the importance of monitoring criteria in text comprehension efforts. This finding indicates that there must be some underlying process that is facilitated by the use of multiple comprehension criteria. If it is assumed that there are different kinds of comprehension problems to be solved in any reading assignment (e.g., disambiguating a sentence, recalling relevant information, or determining the author's goals), students who have access to a wider range of comprehension criteria are more likely to have appropriate criteria for whatever problems a particular text presents. With respect to Kintsch's (1979) model of comprehension, a student with a number of comprehension criteria is likely to be monitoring the several different interdependent levels of the reading process (identifying text propositions, retrieving relevant facts, and constructing a text macrostructure) more effectively than the student with only a single criterion. This interpretation also helps to explain why those students using multiple-standard strategies earn better grades than those using single-standard strategies: Knowledge and Comprehension/Application standards are used by students in the Mixed strategy group to monitor qualitatively different levels of the reading process. Clearly, the monitoring process is complex in a way that the present data only begin to suggest. There must be specific Plans for determining the unit of monitored content (e.g., sentence, paragraph, section, chapter), the level of the process to monitor (e.g., Kintsch's,

1979, propositional, factual, and macrostructural levels), and the particular criteria required for transfer-appropriate processing (Morris et al., 1977) to the examination (e.g., Comprehension/Application criteria for an essay examination, Knowledge criteria for an objective examination).

This study has certain methodological limitations. First, students described their monitoring procedures in whatever terms they chose. For that reason, there is a certain level of ambiguity in the protocols. This ambiguity contributes to the difficulty of identifying the specific criterion used by an individual (e.g., "I know I have understood the chapter if it makes sense to me.") and to the difficulty of determining whether a particular criterion exemplifies Knowledge or Comprehension (e.g., "I know I didn't understand if I had trouble concentrating.") Although the data are clear and consistent, it seems likely that the use of a checklist procedure might enhance the size of the effects shown here and simplify the task of assessing comprehension criteria on a routine basis.

Second, students may not be well informed about their text monitoring strategies (cf. Ericsson & Simon, 1980). Since the retrospective reports of students in this study were useful in predicting course grades (see Table 5), it must be assumed that students do report information that reflects what they do when they evaluate their comprehension. More precise information about the monitoring process might be obtained, however, by using a variation of the planned confusion technique described by Anderson (1979). One might, for example, vary the number of propositions in

each text sentence or the coherence of text paragraphs in different reading materials and ask subjects to provide comprehensibility ratings. The text dimensions that produce the greatest variance in those ratings would then reflect the epistemological criteria employed by a student.

Finally, the use of interview procedures does not allow a clear distinction to be made between epistemological preference and epistemological competence. Dualists, for example, may simply prefer to use Knowledge criteria to monitor comprehension but be perfectly capable of using Comprehension/Application criteria if directed to do so (cf. Markman & Gorin, 1980). On the other hand, Dualists may not be able to conceive of Comrehension/Application criteria or to recognize variations along such text dimensions (cf. Owings, Petersen, Bransford, Morris, & Stein, 1980). The question is most easily resolved by providing examples of different comprehension criteria and asking students to employ each in rating the comprehensibility of passages which vary along appropriate dimensions and which require varying degrees of sensitivity to a given monitoring dimension.

A Cognitive Model of Academic Competence

The focus here on the Image- and Plan-dependent nature of text comprehension monitoring forms the basis for a new conception of academic competence at the undergraduate level. Within this perspective, the college freshman emerges as a naive learning theorist who is required to devise effective learning procedures under conditions of delayed and inadequate feedback. The relevance of a student's epistemological Images and Plans in the assessment and development of academic skills has been

largely ignored in the study skills literature. As important as ability and motivation may appear to be in the learning process, these elements constitute only the resources and the energy that go into learning efforts. It is one's implicit epistemology that organizes and directs the process. The fundamental importance of the Image one has of knowledge and the Plans one has for acquiring knowledge is considered in the following discussion.

There are a number of skills that a college student needs to develop in order to manage his or her learning activities effectively and efficiently. First, one needs strategies for representing text and lecture information (Buzan, 1976; Hanau, 1979). Second, one needs skills for analyzing and synthesizing such information (Adler & Van Doren, 1972). Third, one needs skills for comprehending and memorizing information (Lorayne, 1976; McKowen, 1979). Fourth, one needs decision-making and problem-solving skills (Karlins, 1981; Millman & Pauk, 1969). Fifth, one needs creative skills (Adams, 1976; McKim, 1972). Finally, one needs self-monitoring and self-control skills (Fenker, 1981; Lakein, 1973). Clearly, college students must master a bewildering array of complex intellectual skills before they can fully direct the learning process in which they are engaged.

The task of assessing academic competence becomes manageable when academic skills are described as Plans. There are only two major diagnostic questions: The first is, Does the student monitor the relevant characteristics of his or her behavior in a given skill domain? Owings et al.'s (1980) academically "less successful" fifth graders appeared to

be unable to detect a critical text feature that would have allowed them to focus more effort on difficult stories and less effort on easy stories. This difficulty can be characterized as a monitoring deficiency. The second major diagnostic question is, Does the student engage in information processing operations that are likely to produce changes on whatever stimulus dimension that he or she does monitor? Although Owings et al.'s academically "successful" fifth graders spent more time reading and studying difficult stories, their ability to recall relevant details of these stories was "far from perfect." This difficulty can be characterized as a tactical deficiency. In general, the appropriate diagnostic strategy is to evaluate the quality of a student's academic Plans by assessing the validity of test components and the relevance of operate components. Unfortunately, existing diagnostic schemes fail to view academic skills as feedback-controlled processes. Brown and Holtzman's Survey of Study Habits and Attitudes (1967), for example, is widely recommended (Cranney, 1978; Robinson, 1978), but it contains no items that focus on a student's monitoring capabilities. Thus the Survey can detect neither monitoring deficiencies nor tactical deficiencies.

Any diagnostic procedure must also assess a student's Image of knowledge and of the learning process. A student's epistemological Image plays a crucial role in the development and modification of his or her Plans in any skill domain. It is evident that the monitoring function of the test component would be as critical in a time management Plan as it would be in a text comprehension Plan. What is less evident is the degree to which one's epistemological Image influences all of his or her

academic Plans. A Dualist, for example, might be expected to use time monitoring strategies which focus on the number of hours spent studying or the number of pages read during a study session. A Relativist, on the other hand, might be more likely to use time monitoring strategies which focus on the relationship of a given activity to an established set of personal priorities or the relationship of a given passage of text to pre-established conceptual objectives. The different monitoring strategies that are employed in each of these two cases are likely to promote the development of operational strategies which have very different motivational consequences. Similarly, each of the other academic Plans that a student possesses is likely to bear the imprint of his or her epistemological Image. As a consequence, the monitoring criteria that a student employs in his or her various academic Plans should reflect a common but implicit epistemological stance. The identification of an individual's level of epistemological development is not apt to be a simple diagnostic task. However, Perry's (1970) analysis provides the ingredients for an approach analogous to that taken by diSessa (1982) in her learning path analysis of the development of an understanding of Newtonian mechanics.

The task of improving academic competence assumes a very different character when the Plan- and Image-dependent nature of academic skills is taken into account. Traditional training approaches focus heavily on imparting "hints and tips on skills and techniques (Hills & Potter, 1979, p. 16)." Any training program must make use of attitude change procedures as well as simple instructional procedures. To the extent that a

student is instructed in the use of processing strategies which fail to satisfy his or her epistemological standards, those strategies are not likely to become essential elements in the student's repertoire. Cognitive mapping techniques (which allow a student to use network representations to display the relationships that exist among text elements), for example, are not likely to be perceived as highly valuable by the Dualist seeking to acquire facts at a higher rate with the help of speed-reading techniques.

There is also a certain element of economy in attempting to modify a student's epistemological standards rather than specific behaviors. An impressively large number of actions that might be taken to improve one's academic performance (cf. Pauk, 1976, for a summary), but there are very few ways to monitor knowledge adequately. Since one's epistemological ends influence the development of one's epistemological means, it may be more cost efficient to modify the comprehension monitoring criteria that a student uses than to modify the various study techniques that he or she uses. If one has appropriate comprehension standards, it is at least possible to engage in trial-and-error efforts to develop cognitive operations which satisfy those standards.

Although the amount of research focussing on metacognitive behavior has vastly increased since the publication of Flavell and Wellman's (1977) classic analysis, the relationship between megacognition and cognition is still poorly understood. Kail (1979, p. 23), for example, argues that "the process by which one's understanding of memory influences his mnemonic behaviors is an uninvestigated aspect of the metamemory

field." In this context, the elaboration of Miller et al.'s (1960) conception of Plans and Images presented here offers a useful framework within which to integrate research on metacognitive processes. The epistemological Image represents the perspective from which comprehension monitoring criteria are selected. This Image constitutes an implicit epistemology because it defines the aspects of knowledge structures which an individual can discriminate. Some or all of these aspects are used to define specific epistemological standards against which learning performances may be evaluated. These standards constitute the test component of comprehension Plans. In that capacity, these standards regulate a number of behaviors which serve to modify the input to the test component. Those behaviors constitute the operate component of comprehension Plans. The standards that are implemented in the test component of a Plan, therefore, provide the necessary theoretical link between the beliefs implicit in one's epistemological Image and the behaviors exhibited in the operate phase of his or her comprehension Plan..

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Table 1

Text Monitoring Behaviors of College Students

as a Function of Implicit Epistemological Standards

THE KNOWLEDGE STANDARD

KQ Student recalls information from text in response to chapter or study guide questions (n = 30).

C56835: "I use the self-quizzes in the study guides to determine my level of comprehension. ... . The ones I miss are the ones I use to determine the amount of studying needed. If I don't have study guides or some type of exercises to do, I'm more unsure of my abilities to find useful information."

KR Student recalls information from text during mental review (n = 23).

A13337: "I determine whether I need to read the chapter again or seek help if after reading the chapter I cannot completely go over (with book closed) the entire chapter in my head."

KH Student recalls information from text in response to headings or italicized words (n = 9).

A65435: "The way I check to see if I have understood what I have read is to look back at the different topic headings and try to recall what was said under each topic."

KS Student recalls information from text in response to chapter summary (n = 7).

C73415: "At the end of most chapters, there are key words,

Table 1--Continued

questions, or a summary. If I read those and it's not familiar, or I can't recall a mental picture, I know I wasted my time."

KE Student recalls information from text in response to a re-examination of portions of the text (n = 6).

A76105: "If I can randomly pick a page of material and recognize it."

C69610: "If I do not recognize something when I am reviewing it, I have to go back to find more detailed information on it in the chapter."

KO Student recalls information from text in response to questions from others (n = 5).

C75632: "Sometimes I ask my husband to read the assignment to give me a couple of questions, to make sure that I understood everything."

B48115: "I get together with another individual, and we quiz each other."

KT Student recalls information from text in response to text questions (n = 4).

D14613: "If I do good on the test, I know I read well."

C48313: "I don't ever really know whether I understood material I have read until after a test and even then, I don't know whether the notes or the books are at fault or helped me."

THE COMPREHENSION/APPLICATION STANDARD

Table 1--Continued

CS Student demonstrates comprehension of text by determining the meaning of individual sentences (n = 23).

A32910: "If I don't understand what a passage says, then I know I need more study time."

A80533: "If I felt the material made sense and I understood what they were saying, then I go on."

C36324: "If the vocabulary in the chapter was vague."

CP Student demonstrates comprehension of text by paraphrasing the text (n = 21).

B00702: "I know I've completely understood when I can explain the assignment in my own words (confidently and quickly)."

CI Student demonstrates comprehension of text by integrating different parts of the text into a single framework (n = 6).

C87030: "Reviewing the material I do try to absorb everything and put it all together in my mind. If I can relate the ideas together I usually feel that I can understand the material well enough."

CE Student demonstrates comprehension of text by devising examples of principles and concepts (n = 6).

A43332: "I determine if I have understood it if I can apply it to myself or something I am doing."

A84706: "I try to place the information into a related problem or I try to seek relationships between terms and parts--and how they work in real life--examples and incidents."

Table 1--Continued

CA Student demonstrates comprehension of text by determining the author's intentions or plan (n = 5).

C48020: "I try to figure out just what the author is trying to say and then determine if that is what I have written and understood."

B93303: "When I am reading an assignment I can determine whether or not I understood the material well enough is when I don't have any questions in my head. As for example, 'Why was this mentioned?' 'What's the purpose of stating this information?'"

CL Student demonstrates comprehension of text by integrating text and lecture materials (n = 4).

A28918: "If later, a teacher says something contradictory to what I thought I read, I would ask the lecturer to explain it or go back to read over that part again."

CH Student demonstrates comprehension of text by determining the relationship between sections of text and the associated headings (n = 3).

D42500: "If what I have underlined, marked, etc. enabled me to grasp what the sub-heading was about."

CC Student demonstrates comprehension of text by assessing the level of cognitive effort during the reading process (n = 2).

A35717: "If I was paying attention."

C31910: "My mind starts wandering and I have much poorer concentration when I am having a hard time understanding."

Table 2

Frequency of Different Text Comprehension Monitoring Strategies as a Function of Epistemological Orientation and Inventiveness

Subject Variables	Comprehension Monitoring Strategy		
	Knowledge	Comprehension/ Application	Mixed[a]
Epistemological Orientation:			
Dualist	22	9	15
Relativist	14	18	12
Inventiveness:			
Low	19	11	9
High	13	12	16

[a]Mixed strategies consist of at least one Knowledge-based criterion and at least one Comprehension/Application-based criterion.

Table 3

Frequency of Different Numbers of Comprehension Criteria as a Function of Epistemological Orientation and Inventiveness

Subject Variables	Number of Comprehension Criteria		
	One	Two	Three or more
Epistemological Orientation:			
Dualist	22	17	7
Relativist	19	18	7
Inventiveness:			
Low	20	17	2
High	14	17	10

Table 4

Frequency of Different Levels of Academic Performance

in Introductory Psychology

as a Function of Text Comprehension Monitoring Strategy

Course Grade	Comprehension Monitoring Strategy		
	Knowledge	Comprehension/ Application	Mixed[a]
"Good" (A or B)	9	11	14
"Average" (C)	20	11	11
"Poor" (D or F)	5	4	2

Note. Grades were not available for two students in the Knowledge group and for one student in the Comprehension/Application group.

[a]Mixed strategies consist of at least one Knowledge-based criterion and at least one Comprehension/Application-based criterion.

Table 5

Percentage of "Good" Grades in Introductory Psychology as a Function of the Nature and Number of Comprehension Criteria

Nature of Comprehension Criteria	Number of Comprehension Criteria	
	One	Two or more
Knowledge Only	17% (n = 23)	46% (n = 11)
Comprehension/ Application Only	33% (n = 18)	63% (n = 8)

Note. "Good" grades are defined here as a final course grade of A or B. Grades were not available for two students in the Knowledge Only group and for one student in the Comprehension/Application group.

Appendix A

The Dualism Scale

6. If professors would stick more to the facts and do less theorizing one could get more out of college.

9. The best thing about science courses is that most problems have only one right answer.

15. It is annoying to listen to a lecturer who cannot seem to make up his mind as to what he really believes.

21. It is a waste of time to work on problems which have no possibility of coming out with a clear-cut and unambiguous answer.

25. Educators should know by now which is the best method, lectures or small group discussions.

30. For most questions there is only one right answer once a person is able to get all the facts.

36. A good teacher's job is to keep his students from wandering from the right track.

Note. These items are taken from Perry (1968). Student's ratings of each item are positively scored for dualism.

Appendix B

The Inventiveness Scale

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1. I clarify and apply ideas presented in a lecture or textbook before I attempt to judge.
5. I can control my imagination well enough to picture a detailed sequence of events (e.g., a pot of water slowly coming to a boil and then boiling over) with little effort.
*11. I am reluctant to take a chance on asking a slightly "far-out" question in class or to submit a slightly "far-out" idea in response to a class assignment.
18. I find it easy to create very sharp and detailed mental images of people that I know, places that I have been, and objects that I own.
*22. I have trouble motivating myself to meet and enjoy the challenges that different courses and teachers offer.
*29. I get so impatient to resolve inconsistencies between lecture and textbook materials in a course that I will accept the first and easiest resolution rather than search for the best resolution.
*35. I get uncomfortable when a problem requires that I organize information which is vague and incomplete or that I discover some way to interpret difficult-to-understand or poorly formulated concepts.

Appendix B—Continued

41. I can imagine unpleasant events (e.g., being unable to breathe or falling down a flight of stairs) with getting uncomfortable.

45. I have the confidence to think hard about a problem and then to relax and forget about it for a period of time while my unconscious works on it.

Note. These items have been developed by the author on the basis of Adams' (1976) discussion of different classes of emotional blocks to creative problem solving. Students' ratings of asterisked items are negatively scored for inventiveness; nonasterisked item are positively scored.